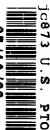


07/12/00



00541890 071200

Please type a plus sign (+) inside this box → ☒Approved for use through 09/30/2000 OMB 0651-0032
Patent and Trademark Office U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))

Attorney Docket No. J 2850First Inventor or Application Identifier CLARK WOODYTitle See 1 in AddendumExpress Mail Label No. EJ484161819US

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. ☒ * Fee Transmittal Form (e.g., PTO/SB/17)
(Submit an original and a duplicate for fee processing)2. ☒ Specification [Total Pages 19]
(preferred arrangement set forth below)

- Descriptive title of the Invention
- Cross References to Related Applications
- Statement Regarding Fed sponsored R & D
- Reference to Microfiche Appendix
- Background of the Invention
- Brief Summary of the Invention
- Brief Description of the Drawings (if filed)
- Detailed Description
- Claim(s)
- Abstract of the Disclosure

3. ☒ Drawing(s) (35 U.S.C. 113) [Total Sheets 6]4. Oath or Declaration [Total Pages 2]

- a. ☒ Newly executed (original or copy)
- b. ☐ Copy from a prior application (37 C.F.R. § 1.63(d))
(for continuation/divisional with Box 16 completed)
- i. ☐ **DELETION OF INVENTOR(S)**
Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).

* NOTE FOR ITEMS 1 & 13 IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).

16. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in a preliminary amendment:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No. _____

Prior application information: Examiner _____

Group / Art Unit: _____

For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

17. CORRESPONDENCE ADDRESS

☐ Customer Number or Bar Code Label

(Insert Customer No. or Attach bar code label here)

or ☒ Correspondence address belowName Kristin L. ChapmanS. C. Johnson Home Storage, Inc.Address 1525 Howe Street, MS 077City RacineState WIZip Code 53403-2236

Country _____

Telephone 262-260-2722Fax 262-260-4253Name (Print/Type) Kristin L. ChapmanRegistration No. (Attorney/Agent) 38,102Signature Kristin L. ChapmanDate 12 July 2000

Burden Hour Statement. This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231

Attachment to PTO/SB/05 (4/98) Utility Patent Application
Transmittal

1. APPARATUS FOR AND METHOD OF SEVERING AND SEALING
THERMOPLASTIC FILM

2015
2014
2013
2012
2011
2010
2009
2008
2007
2006
2005
2004
2003
2002
2001
2000
1999
1998
1997
1996
1995
1994
1993
1992
1991
1990
1989
1988
1987
1986
1985
1984
1983
1982
1981
1980
1979
1978
1977
1976
1975
1974
1973
1972
1971
1970
1969
1968
1967
1966
1965
1964
1963
1962
1961
1960
1959
1958
1957
1956
1955
1954
1953
1952
1951
1950
1949
1948
1947
1946
1945
1944
1943
1942
1941
1940
1939
1938
1937
1936
1935
1934
1933
1932
1931
1930
1929
1928
1927
1926
1925
1924
1923
1922
1921
1920
1919
1918
1917
1916
1915
1914
1913
1912
1911
1910
1909
1908
1907
1906
1905
1904
1903
1902
1901
1900
1899
1898
1897
1896
1895
1894
1893
1892
1891
1890
1889
1888
1887
1886
1885
1884
1883
1882
1881
1880
1879
1878
1877
1876
1875
1874
1873
1872
1871
1870
1869
1868
1867
1866
1865
1864
1863
1862
1861
1860
1859
1858
1857
1856
1855
1854
1853
1852
1851
1850
1849
1848
1847
1846
1845
1844
1843
1842
1841
1840
1839
1838
1837
1836
1835
1834
1833
1832
1831
1830
1829
1828
1827
1826
1825
1824
1823
1822
1821
1820
1819
1818
1817
1816
1815
1814
1813
1812
1811
1810
1809
1808
1807
1806
1805
1804
1803
1802
1801
1800
1799
1798
1797
1796
1795
1794
1793
1792
1791
1790
1789
1788
1787
1786
1785
1784
1783
1782
1781
1780
1779
1778
1777
1776
1775
1774
1773
1772
1771
1770
1769
1768
1767
1766
1765
1764
1763
1762
1761
1760
1759
1758
1757
1756
1755
1754
1753
1752
1751
1750
1749
1748
1747
1746
1745
1744
1743
1742
1741
1740
1739
1738
1737
1736
1735
1734
1733
1732
1731
1730
1729
1728
1727
1726
1725
1724
1723
1722
1721
1720
1719
1718
1717
1716
1715
1714
1713
1712
1711
1710
1709
1708
1707
1706
1705
1704
1703
1702
1701
1700
1699
1698
1697
1696
1695
1694
1693
1692
1691
1690
1689
1688
1687
1686
1685
1684
1683
1682
1681
1680
1679
1678
1677
1676
1675
1674
1673
1672
1671
1670
1669
1668
1667
1666
1665
1664
1663
1662
1661
1660
1659
1658
1657
1656
1655
1654
1653
1652
1651
1650
1649
1648
1647
1646
1645
1644
1643
1642
1641
1640
1639
1638
1637
1636
1635
1634
1633
1632
1631
1630
1629
1628
1627
1626
1625
1624
1623
1622
1621
1620
1619
1618
1617
1616
1615
1614
1613
1612
1611
1610
1609
1608
1607
1606
1605
1604
1603
1602
1601
1600
1599
1598
1597
1596
1595
1594
1593
1592
1591
1590
1589
1588
1587
1586
1585
1584
1583
1582
1581
1580
1579
1578
1577
1576
1575
1574
1573
1572
1571
1570
1569
1568
1567
1566
1565
1564
1563
1562
1561
1560
1559
1558
1557
1556
1555
1554
1553
1552
1551
1550
1549
1548
1547
1546
1545
1544
1543
1542
1541
1540
1539
1538
1537
1536
1535
1534
1533
1532
1531
1530
1529
1528
1527
1526
1525
1524
1523
1522
1521
1520
1519
1518
1517
1516
1515
1514
1513
1512
1511
1510
1509
1508
1507
1506
1505
1504
1503
1502
1501
1500
1499
1498
1497
1496
1495
1494
1493
1492
1491
1490
1489
1488
1487
1486
1485
1484
1483
1482
1481
1480
1479
1478
1477
1476
1475
1474
1473
1472
1471
1470
1469
1468
1467
1466
1465
1464
1463
1462
1461
1460
1459
1458
1457
1456
1455
1454
1453
1452
1451
1450
1449
1448
1447
1446
1445
1444
1443
1442
1441
1440
1439
1438
1437
1436
1435
1434
1433
1432
1431
1430
1429
1428
1427
1426
1425
1424
1423
1422
1421
1420
1419
1418
1417
1416
1415
1414
1413
1412
1411
1410
1409
1408
1407
1406
1405
1404
1403
1402
1401
1400
1399
1398
1397
1396
1395
1394
1393
1392
1391
1390
1389
1388
1387
1386
1385
1384
1383
1382
1381
1380
1379
1378
1377
1376
1375
1374
1373
1372
1371
1370
1369
1368
1367
1366
1365
1364
1363
1362
1361
1360
1359
1358
1357
1356
1355
1354
1353
1352
1351
1350
1349
1348
1347
1346
1345
1344
1343
1342
1341
1340
1339
1338
1337
1336
1335
1334
1333
1332
1331
1330
1329
1328
1327
1326
1325
1324
1323
1322
1321
1320
1319
1318
1317
1316
1315
1314
1313
1312
1311
1310
1309
1308
1307
1306
1305
1304
1303
1302
1301
1300
1299
1298
1297
1296
1295
1294
1293
1292
1291
1290
1289
1288
1287
1286
1285
1284
1283
1282
1281
1280
1279
1278
1277
1276
1275
1274
1273
1272
1271
1270
1269
1268
1267
1266
1265
1264
1263
1262
1261
1260
1259
1258
1257
1256
1255
1254
1253
1252
1251
1250
1249
1248
1247
1246
1245
1244
1243
1242
1241
1240
1239
1238
1237
1236
1235
1234
1233
1232
1231
1230
1229
1228
1227
1226
1225
1224
1223
1222
1221
1220
1219
1218
1217
1216
1215
1214
1213
1212
1211
1210
1209
1208
1207
1206
1205
1204
1203
1202
1201
1200
1199
1198
1197
1196
1195
1194
1193
1192
1191
1190
1189
1188
1187
1186
1185
1184
1183
1182
1181
1180
1179
1178
1177
1176
1175
1174
1173
1172
1171
1170
1169
1168
1167
1166
1165
1164
1163
1162
1161
1160
1159
1158
1157
1156
1155
1154
1153
1152
1151
1150
1149
1148
1147
1146
1145
1144
1143
1142
1141
1140
1139
1138
1137
1136
1135
1134
1133
1132
1131
1130
1129
1128
1127
1126
1125
1124
1123
1122
1121
1120
1119
1118
1117
1116
1115
1114
1113
1112
1111
1110
1109
1108
1107
1106
1105
1104
1103
1102
1101
1100
1099
1098
1097
1096
1095
1094
1093
1092
1091
1090
1089
1088
1087
1086
1085
1084
1083
1082
1081
1080
1079
1078
1077
1076
1075
1074
1073
1072
1071
1070
1069
1068
1067
1066
1065
1064
1063
1062
1061
1060
1059
1058
1057
1056
1055
1054
1053
1052
1051
1050
1049
1048
1047
1046
1045
1044
1043
1042
1041
1040
1039
1038
1037
1036
1035
1034
1033
1032
1031
1030
1029
1028
1027
1026
1025
1024
1023
1022
1021
1020
1019
1018
1017
1016
1015
1014
1013
1012
1011
1010
1009
1008
1007
1006
1005
1004
1003
1002
1001
1000
999
998
997
996
995
994
993
992
991
990
989
988
987
986
985
984
983
982
981
980
979
978
977
976
975
974
973
972
971
970
969
968
967
966
965
964
963
962
961
960
959
958
957
956
955
954
953
952
951
950
949
948
947
946
945
944
943
942
941
940
939
938
937
936
935
934
933
932
931
930
929
928
927
926
925
924
923
922
921
920
919
918
917
916
915
914
913
912
911
910
909
908
907
906
905
904
903
902
901
900
899
898
897
896
895
894
893
892
891
890
889
888
887
886
885
884
883
882
881
880
879
878
877
876
875
874
873
872
871
870
869
868
867
866
865
864
863
862
861
860
859
858
857
856
855
854
853
852
851
850
849
848
847
846
845
844
843
842
841
840
839
838
837
836
835
834
833
832
831
830
829
828
827
826
825
824
823
822
821
820
819
818
817
816
815
814
813
812
811
810
809
808
807
806
805
804
803
802
801
800
799
798
797
796
795
794
793
792
791
790
789
788
787
786
785
784
783
782
781
780
779
778
777
776
775
774
773
772
771
770
769
768
767
766
765
764
763
762
761
760
759
758
757
756
755
754
753
752
751
750
749
748
747
746
745
744
743
742
741
740
739
738
737
736
735
734
733
732
731
730
729
728
727
726
725
724
723
722
721
720
719
718
717
716
715
714
713
712
711
710
709
708
707
706
705
704
703
702
701
700
699
698
697
696
695
694
693
692
691
690
689
688
687
686
685
684
683
682
681
680
679
678
677
676
675
674
673
672
671
670
669
668
667
666
665
664
663
662
661
660
659
658
657
656
655
654
653
652
651
650
649
648
647
646
645
644
643
642
641
640
639
638
637
636
635
634
633
632
631
630
629
628
627
626
625
624
623
622
621
620
619
618
617
616
615
614
613
612
611
610
609
608
607
606
605
604
603
602
601
600
599
598
597
596
595
594
593
592
591
590
589
588
587
586
585
584
583
582
581
580
579
578
577
576
575
574
573
572
571
570
569
568
567
566
565
564
563
562
561
560
559
558
557
556
555
554
553
552
551
550
549
548
547
546
545
544
543
542
541
540
539
538
537
536
535
534
533
532
531
530
529
528
527
526
525
524
523
522
521
520
519
518
517
516
515
514
513
512
511
510
509
508
507
506
505
504
503
502
501
500
499
498
497
496
495
494
493
492
491
490
489
488
487
486
485
484
483
482
481
480
479
478
477
476
475
474
473
472
471
470
469
468
467
466
465
464
463
462
461
460
459
458
457
456
455
454
453
452
451
450
449
448
447
446
445
444
443
442
441
440
439
438
437
436
435
434
433
432
431
430
429
428
427
426
425
424
423
422
421
420
419
418
417
416
415
414
413
412
411
410
409
408
407
406
405
404
403
402
401
400
399
398
397
396
395
394
393
392
391
390
389
388
387
386
385
384
383
382
381
380
379
378
377
376
375
374
373
372
371
370
369
368
367
366
365
364
363
362
361
360
359
358
357
356
355
354
353
352
351
350
349
348
347
346
345
344
343
342
341
340
339
338
337
336
335
334
333
332
331
330
329
328
327
326
325
324
323
322
321
320
319
318
317
316
315
314
313
312
311
310
309
308
307
306
305
304
303
302
301
300
299
298
297
296
295
294
293
292
291
290
289
288
287
286
285
284
283
282
281
280
279
278
277
276
275
274
273
272
271
270
269
268
267
266
265
264
263
262
261
260
259
258
257
256
255
254
253
252
251
250
249
248
247
246
245
244
243
242
241
240
239
238
237
236
235
234
233
232
231
230
229
228
227
226
225
224
223
222
221
220
219
218
217
216
215
214
213
212
211
210
209
208
207
206
205
204
203
202
201
200
199
198
197
196
195
194
193
192
191
190
189
188
187
186
185
184
183
182
181
180
179
178
177
176
175
174
173
172
171
170
169
168
167
166
165
164
163
162
161
160
159
158
157
156
155
154
153
152
151
150
149
148
147
146
145
144
143
142
141
140
139
138
137
136
135
134
133
132
131
130
129
128
127
126
125
124
123
122
121
120
119
118
117
116
115
114
113
112
111
110
109
108
107
106
105
104
103
102
101
100
99
98
97
96
95
94
93
92
91
90
89
88
87
86
85
84
83
82
81
80
79
78
77
76
75
74
73
72
71
70
69
68
67
66
65
64
63
62
61
60
59
58
57
56
55
54
53
52
51
50
49
48
47
46
45
44
43
42
41
40
39
38
37
36
35
34
33
32
31
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0

**APPARATUS FOR AND METHOD OF SEVERING
AND SEALING THERMOPLASTIC FILM**

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to an apparatus for and a method of severing and sealing thermoplastic film to make plastic bags or the like, and in particular to an apparatus and a method that utilize a combination of thermal energy and mechanical force to sever and seal the thermoplastic film.

2. Description of the Related Art

In the production of plastic bags, a continuous web of thermoplastic film typically is supplied to a bag-making machine that severs the film into segments and seals the severed edges of each segment to form a bag.

Referring to FIG. 1, a known bag-making machine is designated generally by reference numeral 10. The machine shown is a dual-lane bag-making machine.

That is, two folded webs of thermoplastic film 22 are fed to the machine 10 in parallel, and the machine 10 severs and seals the parallel webs to form two sets of bags.

The bag-making machine 10 includes a continuously rotating seal drum 12 and a cam track assembly 14. Folded webs of thermoplastic film 22 are fed between the seal drum 12 and the cam track assembly 14. A plurality of clamping devices 16, such as disclosed in U.S. Patent No. 5,964,688, assigned to the same assignee as the present invention and incorporated herein by reference in its entirety, is mounted on the cam track assembly 14 for movement therearound. As best seen in FIG. 2, each clamping device 16 comprises a pair of parallel spring-mounted seal bars 18, separated by a gap 20.

The clamping devices 16 intermittently contact the film 22 and clamp it firmly against the seal drum 12. A cam-actuated, electrically-heated hot wire 24 advances

through an opening 26 in the surface of the seal drum 12, burns its way through the film 22, and moves into the gap 20 between the seal bars 18. In this way, the film 22 is severed into segments and the resulting severed edges are simultaneously sealed.

As shown in FIG. 3, a typical hot wire 24 consists of a relatively thin, elongated piece of electrically-conductive material stretched between supports 28 disposed on opposite sides of the effective cutting lengths 30 of the hot wire 24. To date, hot wires of various sizes and shapes have been used. For instance, some processes have employed hot wires having circular cross sections with diameters up to about 0.050 inches. Other processes have employed rectangular or wedge-shaped hot wires. Such conventional hot wires generally are heated to temperatures between 100-1400°F.

Several problems exist in the production of plastic bags using conventional bag-making machines such as that described above. For example, as the hot wire burns its way through the film, a significant amount of smoke is produced. Some of this smoke condenses on components of the machine, leaving behind a wax residue. On an almost daily basis, the machine must be shut down and the components cleaned in order to remove the wax buildup. Another problem with conventional bag-making machines is that the relatively thin, high-temperature hot wires often fail due to the stress of repeated severing and sealing operations. Replacing broken wires requires additional downtime for the machine and results in a further reduction in productivity.

Accordingly, there is a need in the art for an improved apparatus for and method of severing and sealing thermoplastic film to form plastic bags or the like.

There is a further need for such an apparatus and method that reduce the amount of wax that accumulates on the components of the apparatus.

There is a still further need for such an apparatus and method wherein the hot wire used to sever and seal the film will not easily break when subjected to repeated severing and sealing operations.

SUMMARY OF THE INVENTION

The present invention addresses the foregoing needs in the art by providing an apparatus for and a method of severing and sealing thermoplastic film that utilizes a cutting edge implement heated to a lower temperature than hot wires utilized in conventional bag-making machines, and that applies a combination of thermal energy and mechanical force to sever and seal the film.

In a first aspect of the present invention, a method of severing and sealing a film formed of a thermoplastic material includes heating a cutting edge implement to a temperature sufficient to melt but not to burn the thermoplastic material, feeding a plurality of layers of the film between the cutting edge implement and an opposing surface, and moving the cutting edge implement and the opposing surface relative to one another to pinch the plurality of layers of film therebetween. Thereafter, any relative lateral movement between the cutting edge implement, the film, and the opposing surface is suspended, while the cutting edge implement and the opposing surface are relatively biased together with the plurality of layers of film pinched therebetween, until the cutting edge implement cuts through the plurality of layers of film, contacts the opposing surface, and seals the plurality of layers of film together.

In another aspect, a method of severing and sealing a film includes clamping the film between opposing surfaces, heating a cutting edge implement to a temperature sufficient to melt but not to burn the film, and moving the cutting edge implement past one of the opposing surfaces toward the other surface so that the cutting edge implement presses against the film toward the other surface for a period of time sufficient to sever the film and seal the resulting severed edges.

In still another aspect, an apparatus for severing and sealing a film formed of a thermoplastic material includes a cutting edge implement that is heatable to a temperature sufficient to melt but not to burn the thermoplastic material, an anvil, and means for feeding a plurality of layers of the film between the cutting edge implement and the anvil. The apparatus further includes means for moving the cutting edge implement and the anvil relative to one another to pinch the plurality of layers of film therebetween, and means for suspending any relative lateral movement between the cutting edge implement, the film, and the anvil, while

pressing the cutting edge implement toward the anvil with the film pinched therebetween, until the cutting edge implement melts through the plurality of layers of film, contacts the anvil, and seals the plurality of layers of film together.

In a further aspect, a method of severing and sealing a film formed of a thermoplastic material includes pinching a plurality of layers of the film between a substrate and a cutting edge implement that is heated to a temperature sufficient to melt but not to burn the thermoplastic material, and pressing the cutting edge implement toward the substrate with the plurality of layers of film pinched therebetween, until the cutting edge implement melts through the plurality of layers of film, contacts the substrate, and seals the plurality of layers of film together.

In each of these aspects, it is preferred that the cutting edge implement be a hot wire. Preferably, the hot wire is supported along substantially its entire effective cutting length.

A better understanding of these and other objects, features, and advantages of the present invention may be had by reference to the drawings and to the accompanying description, in which there are illustrated and described preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a conventional bag-making machine.

FIG. 2 is a cross-sectional view of a typical hot wire assembly and opposing clamping device utilized in the bag-making machine of FIG. 1.

FIG. 3 is a cross-sectional view taken along cross section line 3-3 in FIG. 2.

FIG. 4 is a perspective view of a severing and sealing apparatus according to a preferred embodiment of the present invention.

FIG. 5 is a cross-sectional view of a cutting assembly and opposing anvil assembly utilized in the severing and sealing apparatus of FIG. 4.

FIG. 6 is a cross-sectional view taken along cross section line 6-6 in FIG. 5.

Throughout the figures, like reference numerals have been used for like or corresponding parts.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

For illustrative purposes, the severing and sealing apparatus and method of the present invention are described in connection with the production of plastic bags made from a folded web of polyethylene film (by way of example, but not limitation, either completely low density or a blend of low density and linear low density, depending on the desired bag parameters). In forming such bags, the film is typically folded such that it is closed along one edge and open along the other. Mating zipper elements (or other suitable closure mechanisms) are provided along the open edge. The closed (or folded) edge can further be folded inward to form a pleat. Thus, the web is four plies thick near the closed edge, and two plies thick near the open edge (plus the thickness of the zipper elements). The web is severed and sealed transversely to form the lateral edges of the bags.

The present invention also can be utilized in the production of bags made from other thermoplastic materials, such as polypropylene or the like, as well as in the production of bags from films of varying thicknesses, or from webs having different configurations (such as webs having fewer or more layers, webs incorporating zipper elements, slider closure mechanisms, drawstrings, etc.), or even from multiple webs stacked on top of one another (e.g., back-to-back bags) or nested within each other (e.g., a bag-in-a-bag).

The severing and sealing apparatus and method of the present invention represent improvements over the known bag-making machines and methods discussed above. The improvements include, among others, replacing the spaced seal bars with one-piece anvils, replacing the relatively thin, high-temperature hot wires with larger, lower-temperature cutting edge implements, and supporting the cutting edge implements for substantially their entire lengths.

Referring to FIG. 4, a severing and sealing apparatus according to a preferred embodiment of the present invention is designated generally by reference numeral 100. The apparatus shown is a dual-lane severing and sealing apparatus. That is, two folded webs of polyethylene film are fed to the apparatus in parallel, and the apparatus severs and seals the parallel webs to form two sets of bags. The

severing and sealing apparatus of the present invention readily can be adapted for use in a single-lane or other multiple-lane production line.

In a preferred embodiment, the severing and sealing apparatus 100 generally comprises a continuously rotating cylindrical seal drum 102 and a generally kidney-shaped cam track assembly 104, comprising a pair of opposing anvil cam tracks. The anvil cam tracks run parallel to the seal drum 102 for approximately one-third of the circumference of the seal drum 102. A plurality of anvil assemblies 106 is mounted at spaced intervals around the cam track assembly 104 for movement on the anvil cam tracks. The anvil assemblies 106 are interconnected by one or more chains (not shown) so that they can be commonly driven.

The anvil assemblies 106 move around the cam track assembly 104 at approximately the peripheral speed of the rotating seal drum 102. Preferably, the seal drum 102 and anvil assemblies 106 are commonly driven by a known motor and gear train (not shown). Any of a number of other known mechanisms can similarly be used to rotate the seal drum 102 and to move the anvil assemblies 106 around the cam track assembly 104. Alternatively, the seal drum 102 and anvil assemblies 106 can be driven by separate devices.

Referring to FIG. 5, continuous folded webs of polyethylene film 108 are fed between the seal drum 102 and the cam track assembly 104 of the severing and sealing apparatus 100 by known means, such as feed rollers (not shown) or the like.

The seal drum 102 and anvil assemblies 106 together clamp the film 108 and advance it through the severing and sealing apparatus 100.

The seal drum 102 includes a plurality of cutting assemblies 114 reciprocally mounted at spaced intervals around the interior of the seal drum 102. The spacing between the cutting assemblies 114 and the spacing between the anvil assemblies 106 correspond, so that each cutting assembly 114 registers with a respective anvil assembly 106 for a distance as the seal drum 102 rotates and the anvil assemblies 106 move around the cam track assembly 104. Each cutting assembly 114 includes a reciprocally-mounted cutting edge implement, preferably an elongated hot wire 110, which is heated. The hot wire 110 is intermittently advanced through a respective opening 112 in the surface of the seal drum 102 to contact the film 108

and press it against an opposing anvil assembly 106. The film 108 remains pinched between the hot wire 110 and the anvil assembly 106 until the hot wire 110 melts through the layers of the film 108, contacts the anvil assembly 106, and seals the layers of the film 108 together.

Each hot wire 110 is held taut and is electrically coupled at either end, and is also preferably supported for substantially its entire length by an electrically- and thermally-insulating material. The hot wire 110 preferably has a larger cross section than conventional hot wires, and is maintained at a temperature that will melt, but not burn, the film 108.

The structure of a preferred cutting assembly 114 is explained below with reference to FIGS. 5 and 6. The hot wire 110 is coupled at each end to an end-clip finger 116 by a screw or the like. The hot wire 110 and the end-clip fingers 116 preferably are constructed of electrically-conductive materials. Most preferably, the hot wire 110 is made of a high-nickel content alloy, such as Inconel®, Monel®, Hastello®C, or the like, and the end-clip fingers 116 are made of cold-rolled steel.

A suitable electrical source (not shown) supplies electrical current to the hot wire 110 via electrical leads (not shown) coupled to the end-clip fingers 116.

Alternatively, the leads could be directly connected to the hot wire 110, in which case the end-clip fingers 116 would not need to be electrically conductive.

Moreover, the hot wire 110 could be heated by other means, such as embedded cartridge heaters, radiation, or the like.

Enough current (or other form of energy) is supplied to the hot wire 110 to heat it to an elevated temperature at which the polyethylene film 108 will melt, but not burn. The inventors have found that heating the hot wire 110 to a temperature of about 800° F or lower will avoid burning the polyethylene film 108, and consequently, will not cause any substantial accumulation of wax on the components of the apparatus 100. Preferably, the hot wire 110 is heated to a temperature between about 600° F to about 800° F. Of course, those of ordinary skill in the art will understand that the effective temperature range will vary according to the type of thermoplastic film, the thickness of the film, the dwell time during which the hot wire contacts the film, and the pressure exerted on the film by the hot wire.

For example, for a particular film having a given thickness, a lower-temperature hot wire will typically require a relatively longer period of contact with the film and/or a greater exertion of pressure on the film in order to sever and seal the film.

In a preferred embodiment, the hot wire 110 is approximately 0.050 inches wide by approximately 0.250 inches tall. The leading edge of the hot wire 110 that is used to sever and seal the polyethylene film 108 is rounded, having a radius of 0.025 inches. A rounded leading edge is preferred because it sufficiently concentrates the cutting force, yet does not dissipate heat to the ambient to the extent that a sharply-pointed leading edge would. By increasing the cross section of the hot wire 110 (compared to known devices) and supporting it for substantially its entire length, the hot wire 110 of the present invention is rendered considerably more durable than conventional hot wires.

One skilled in the art will appreciate that hot wires of different shapes could be employed, for example, hot wires having circular, elliptical, square, rectangular, wedge-shaped, or other profiles. Moreover, hot wires having larger or smaller cross-sectional areas could be used, provided the cross-sectional area of the hot wire is large enough to store a sufficient amount of thermal energy to sever and seal the film, yet small enough that the hot wire can be efficiently heated with a reasonable input of energy.

In a preferred embodiment, the hot wire 110 rests in a groove formed in an electrically- and thermally-insulating insert 118, preferably made of Cogetherm™ 505 mica. Alternatively, the insert 118 can be constructed of other insulating materials, such as, for example, ceramic, glass, or another form of mica. The insert 118, in turn, is fitted into a groove formed in a hot wire base member 120, preferably made of grade G7 Garolite™, a woven glass fabric which is laminated together with a silicone resin. Alternatively, the base member 120 can be made of Teflon®, hardwoods, phenolics, or high-temperature resistant plastics. The hot wire 110 can extend across the paths of both webs in the dual-lane apparatus. Between the effective cutting lengths 124 of the hot wire 110, a center cap 122 is mounted over both the hot wire 110 and the insert 118 to secure the hot wire 110 and the insert 118 to the hot wire base member 120.

The hot wire base member 120 is mounted on a hot wire superstructure 126 by screws or the like. Preferably, the hot wire superstructure 126 is constructed of aluminum or a comparable lightweight and rigid material. The end-clip fingers 116 are spring mounted at opposite ends of the hot wire superstructure 126 and can slide toward and away from one another. Thus, the end-clip fingers 116 maintain the hot wire taut regardless of expansion and contraction of the hot wire 110 caused by temperature fluctuations.

The hot wire superstructure 126 is mounted near opposite ends thereof to a pair of follower arms 128. Each follower arm 128 comprises an upper and a lower arm 164, 166, held together by shoulder bolts (not shown) and biased apart a relatively small distance by a compression spring 168. In a preferred embodiment, each spring 168, when compressed, exerts a force of about 54 lbf. Thus, the springs 168 of each cutting assembly 114 are capable of exerting a collective force of about 108 lbf.

Each lower follower arm 166 includes a cam follower 130, adapted for movement along a respective cam track 132. As the seal drum 102 rotates, the cam followers 130 move along the cam tracks 132, thereby reciprocating the cutting assemblies 114 radially inward and outward. The cam tracks 132 are designed such that each hot wire 110 is extended through a respective opening 112 in the surface of the seal drum 102 for approximately one-third of each revolution of the seal drum 102 (during which the anvil cam tracks of the cam track assembly 104 run parallel to the seal drum 102), and retracted within the interior of the seal drum 102 for the remainder of each revolution.

In the preferred embodiment shown, the cutting assemblies 114 are reciprocated using a cam arrangement. However, one skilled in the art will appreciate that other arrangements are possible. For example, a linear actuator, pneumatic or hydraulic cylinder, solenoid, or the like could be employed to reciprocate the cutting assemblies 114.

In the preferred embodiment described above, the heated cutting edge implement is a hot wire 110, preferably supported for substantially its entire effective cutting lengths 124 by an insulating material, and preferably made of a high-nickel

content alloy. The heated cutting edge implement can be constructed of any heatable material, however, and need not necessarily be supported for substantially its entire length. In addition, the heated cutting edge implement can be heated either continuously or intermittently. Thus, any heated cutting edge implement that is used to sever and/or seal thermoplastic film, such as hot wires, hot knives, heating bars, and the like, falls within the broad scope of the invention.

The structure of a preferred anvil assembly 106 is explained with reference to FIGS. 5 and 6. Each anvil assembly 106 includes a pair of spring-loaded anvils 134 (one corresponding to each cutting length 124 of the hot wire 110) that contact the film 108 and clamp it against the seal drum 102. Preferably, each anvil 134 comprises a block of silicone rubber 136 having a strip of Teflon® tape 138 applied thereto. The Teflon® tape 138 helps to prevent the film 108 from adhering to the silicone rubber block 136.

Due to the combined spring force of the springs 168, each cutting assembly 114 preferably exerts a maximum force of about 108 lbf on an opposing anvil assembly 106. For this particular load, the inventors have found that a silicone rubber block having a hardness of 70 durometers is preferred. However, those skilled in the art will understand that softer or harder rubbers or other materials also could be used for the block, provided the selected material does not readily deform when subjected to the given load.

Each anvil 134 is mounted on a plate 140, preferably made of aluminum. The plate 140 is bracketed to an anvil base member 142, also preferably made of aluminum. The plate 140 is easily detachable from the anvil base member 142 to permit simple replacement of worn or damaged anvils 134. Two anvil base members 142 are mounted on an anvil superstructure 144, which is itself mounted on the cam track assembly 104 for movement thereabout.

The anvil superstructure 144 contains a number of holes 148, each of which has a slide pin 150 press-fitted or bolted therein. Each slide pin 150 extends out of the hole 148 and through a bushing 152 countersunk within a corresponding hole 146 in a respective anvil base member 142. A compression spring 154 interposed around each slide pin 150 biases the anvil superstructure 144 and the anvil base

member 142 apart. In the preferred embodiment shown, four slide pins 150 and four springs 154 are used to mount each anvil base member 142, with one slide pin 150 and one spring 154 employed near each respective corner of the anvil base member 142. Motion limiters can be provided to prevent the anvil superstructure 144 and the anvil base member 142 from completely disengaging.

Additionally, tooling ball stems 156 (one or more corresponding to each anvil base member 142) are press-fitted or bolted in holes 158 in the anvil superstructure 144. Each stem 156 terminates in a tooling ball 160, which is received in a sleeve 162 located in or near the center of a respective anvil base member 142. The tooling ball 160 provides a point (or if two tooling balls are used, an axis) about which a respective anvil base member 142 can pivot. Thus, the anvil base members 142 are able to pivot independently about a respective tooling ball 160, enabling each anvil base member 142 to tilt as needed in order to clamp the film 108 firmly against the seal drum 102.

The anvil assembly springs 154 preferably are strong enough to resist the compressive force exerted by the hot wire 110 as it presses the film 108 against the anvils 134, yet are sufficiently elastic to permit the anvils 134 to properly align with the seal drum 102 during the clamping process. As noted, in a preferred embodiment, each cutting assembly 114 is capable of exerting a maximum force of about 108 lbf on an opposing anvil assembly 106. The inventors have found that anvil assembly springs 154 capable of exerting a collective force of about 112 lbf (14 lbf per spring) are satisfactory for this purpose.

The operation of the severing and sealing apparatus 100 will next be described.

A continuous folded web of, for example, polyethylene film 108, is fed to the apparatus 100 between the rotating seal drum 102 and counter-rotating anvil assemblies 106. One of the anvils 134 contacts the film 108 and clamps it firmly against the seal drum 102. Meanwhile, one of the hot wires 110 is advanced through a respective opening 112 in the surface of the seal drum 102 and contacts the film 108, thereby sandwiching the film 108 between the hot wire 110 and the opposing anvil 134. Thereafter, the hot wire 110 moves laterally in synchronization

with the film 108 and the anvil 134, while the film 108 remains pinched between the hot wire 110 and the anvil 134 for a period of time sufficient to sever the film 108 and seal the resulting severed edges. This period of time is commonly referred to as the dwell time. The inventors have found that a dwell time of approximately one second, together with the exertion of about 108 lbf on the film 108 by the hot wire 110, is sufficient to sever and seal the film 108 using a hot wire 110 heated to a temperature between about 600° F to about 800° F. The dwell time, contact pressure, and hot wire temperature may be manipulated to arrive at other combinations that will effectively sever and seal the film, but not burn it, all of which fall within the broad scope of the invention. In this regard, one of ordinary skill in the art will appreciate that the dwell time readily can be varied simply by adjusting the rotational speed of the seal drum 102 and anvil assemblies 106, and that the contact pressure can be varied by using fewer or more springs 154, 168, or by using springs having lower or higher compressive strengths.

After the film 108 is severed and sealed, the hot wire 110 is retracted within the interior of the seal drum 102 for the remainder of the drum revolution, before again being advanced through the opening 112 in the seal drum 102 to sever and seal another segment of the film 108. While the hot wire 110 is retracted within the interior of the seal drum 102, it reheats to the desired elevated temperature to make up for heat dissipated in the severing and sealing process. The resulting bags are temporarily retained on the seal drum 102 by a vacuum, before being transferred to another piece of equipment, such as, for example, a transfer drum (not shown).

One of ordinary skill in the art will appreciate that numerous variations on the particular embodiments described above are possible, and that such variations fall within the scope of the present invention. For example, the track assembly and seal drum could have any number of configurations. One possibility is to have a pair of counter-rotating tank-tread-shaped belts, carrying a plurality of hot wire assemblies and anvil assemblies, respectively. An advantage of such an embodiment is that the opposing straight sections of the tank-tread-shaped belts can be made as long as desired, thereby providing a longer dwell time without decreasing the production rate.

In another embodiment, the film could be advanced intermittently between a hot wire assembly and an anvil assembly, which do not move in the direction in which the film is fed. The hot wire assembly and anvil assembly could then close together to sandwich the film therebetween for a period of time sufficient to sever and seal the film.

The embodiments discussed above are representative of embodiments of the present invention and are provided for illustrative purposes only. They are not intended to limit the scope of the present invention. Although components, materials, configurations, temperatures, times, etc., have been shown and described, such are not limiting. Modifications and variations are contemplated within the scope of the present invention, which is intended to be limited only by the scope of the accompanying claims.

INDUSTRIAL APPLICABILITY

The apparatus and method of the present invention are suited for severing and sealing thermoplastic film in the high-speed production of plastic bags. As the film is fed through the severing and sealing apparatus, a cutting edge implement, heated to a temperature sufficient to melt but not to burn the film, contacts the film and presses it against an opposing anvil. The film remains pinched between the cutting edge implement and the anvil for a period of time sufficient to sever and seal the film.

WE CLAIM:

1. A method of severing and sealing a film formed of a thermoplastic material, comprising the steps of:

heating a cutting edge implement to a temperature sufficient to melt but not to burn the thermoplastic material;

feeding a plurality of layers of the film between the cutting edge implement and an opposing surface;

moving the cutting edge implement and the opposing surface relative to one another to pinch the plurality of layers of film therebetween; and

thereafter, suspending any relative lateral movement between the cutting edge implement, the film, and the opposing surface, while relatively biasing the cutting edge implement and the opposing surface together with the plurality of layers of film pinched therebetween, until the cutting edge implement cuts through the plurality of layers of film, contacts the opposing surface, and seals the plurality of layers of film together.

2. A method according to claim 1, wherein the moving step comprises the step of advancing the cutting edge implement in a direction substantially perpendicular relative to a contact area of the opposing surface.

3. A method according to claim 1, wherein the suspending step comprises synchronously moving the cutting edge implement, the film, and the opposing surface in substantially the same lateral direction.

4. A method according to claim 1, wherein the cutting edge implement is a hot wire, and further comprising the step of, prior to the moving step, supporting the hot wire for substantially its entire effective cutting length.

5. A method according to claim 1, wherein the heating step comprises heating the cutting edge implement to a temperature of less than 800° F.

6. A method according to claim 1, wherein the heating step comprises heating the cutting edge implement to a temperature between about 600° F to about 800° F.

7. A method according to claim 1, wherein the suspending step comprises suspending relative lateral movement between the cutting edge implement, the film, and the opposing surface for approximately one second.

8. A method of severing and sealing a film, comprising the steps of:
clamping the film between opposing surfaces;
heating a cutting edge implement to a temperature sufficient to melt but not to burn the film; and
moving the cutting edge implement past one of the opposing surfaces toward the other surface so that the cutting edge implement presses against the film toward the other surface for a period of time sufficient to sever the film and seal the resulting severed edges.

9. A method according to claim 8, wherein the heating step comprises heating the cutting edge implement to a temperature of less than approximately 800° F.

10. A method according to claim 8, wherein the heating step comprises heating the cutting edge implement to a temperature between 600° F to about 800° F.

11. A method according to claim 8, wherein the cutting edge implement is a hot wire, and further comprising the step of supporting the hot wire for substantially its entire effective cutting length.

12. A method according to claim 8, wherein the passing step comprises pinching the film between the cutting edge implement and the other surface for approximately one second.

13. A method according to claim 8, wherein the passing step comprises advancing the cutting edge implement through an opening in the one opposing surface.

14. A method according to claim 8, wherein the clamping step comprises clamping the film between a rotating drum and an anvil that travels around a closed path at approximately the peripheral speed of the rotating drum.

15. An apparatus for severing and sealing a film formed of a thermoplastic material, comprising:

- a cutting edge implement that is heatable to a temperature sufficient to melt but not to burn the thermoplastic material;

- an anvil;

- means for feeding a plurality of layers of the film between the cutting edge implement and the anvil;

- means for moving the cutting edge implement and the anvil relative to one another to pinch the plurality of layers of film therebetween;

- means for suspending any relative lateral movement between the cutting edge implement, the film, and the anvil, while pressing the cutting edge implement toward the anvil with the film pinched therebetween, until the cutting edge implement melts through the plurality of layers of film, contacts the anvil, and seals the plurality of layers of film together.

16. An apparatus according to claim 15, further comprising:

- means for laterally moving the cutting edge implement along a closed path; and

- means for moving the anvil along a path that is at least in part substantially parallel to a portion of the closed path traveled by the cutting edge implement.

17. An apparatus according to claim 16, wherein the cutting edge implement, the film, and the anvil all synchronously move in substantially the same lateral direction while the film is melted and sealed.

18. An apparatus according to claim 15, wherein the cutting edge implement is a hot wire that is supported for substantially its entire effective cutting length by an insulating member.

19. An apparatus according to claim 15, wherein the cutting edge implement is heated to a temperature of less than approximately 800°.

20. An apparatus according to claim 15, wherein the cutting edge implement is heated to a temperature between about 600° F to about 800° F.

21. An apparatus according to claim 15, wherein the cutting edge implement comprises a hot wire.

22. An apparatus according to claim 15, wherein the suspending means suspends any relative lateral movement between the cutting edge implement, the film, and the anvil for approximately one second.

23. A method of severing and sealing a film formed of a thermoplastic material, comprising:

pinching a plurality of layers of the film between a substrate and a cutting edge implement that is heated to a temperature sufficient to melt but not to burn the thermoplastic material; and

pressing the cutting edge implement toward the substrate with the plurality of layers of film pinched therebetween, until the cutting edge implement melts through the plurality of layers of film, contacts the substrate, and seals the plurality of layers of film together.

24. A method according to claim 23, further comprising the step of feeding the plurality of layers of film in a lateral direction, and synchronously moving the substrate and the cutting edge implement in the lateral direction during the pinching and pressing steps.

25. A method according to claim 23, further comprising, prior to the pinching step, heating the cutting edge implement to the sufficient temperature.

26. A method according to claim 23, wherein the cutting edge implement is a hot wire, and further comprising the step of, prior to the pinching and pressing steps, supporting the hot wire for substantially its entire effective cutting length.

ABSTRACT OF THE DISCLOSURE

5 A method of severing and sealing a film formed of a thermoplastic material includes heating a cutting edge implement to a temperature sufficient to melt but not to burn the thermoplastic material, feeding a plurality of layers of the film between the cutting edge implement and an opposing surface, and moving the cutting edge implement, which is preferably a supported hot wire, and the opposing surface relative to one another to pinch the plurality of layers of film therebetween.

Thereafter, any relative lateral movement between the cutting edge implement, the film, and the opposing surface is suspended, while the cutting edge implement and the opposing surface are relatively biased together with the plurality of layers of film pinched therebetween, until the cutting edge implement cuts through the plurality of layers of film, contacts the opposing surface, and seals the plurality of layers of film together.

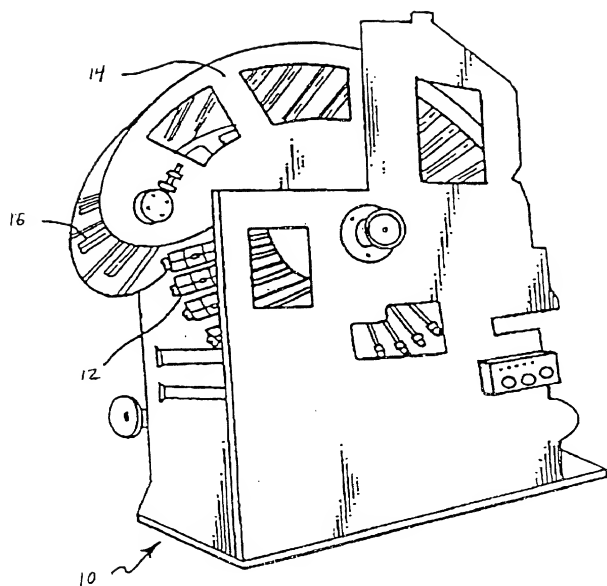


FIG. 1

09514898.071200

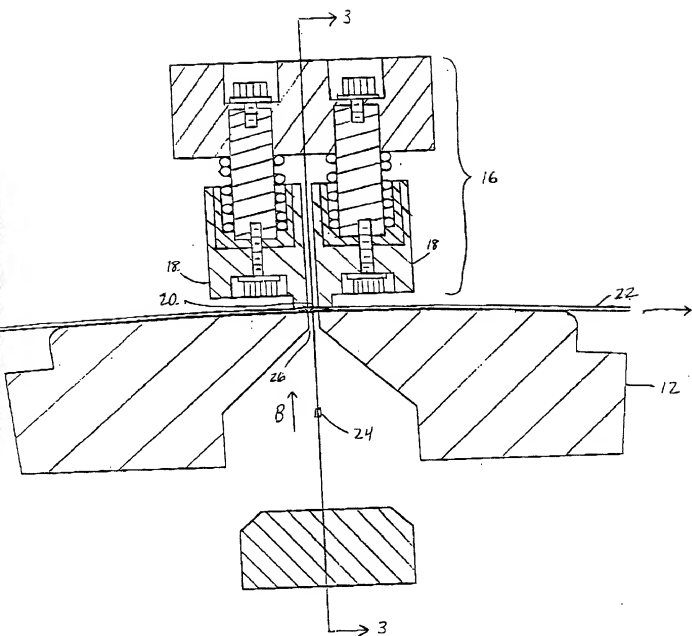
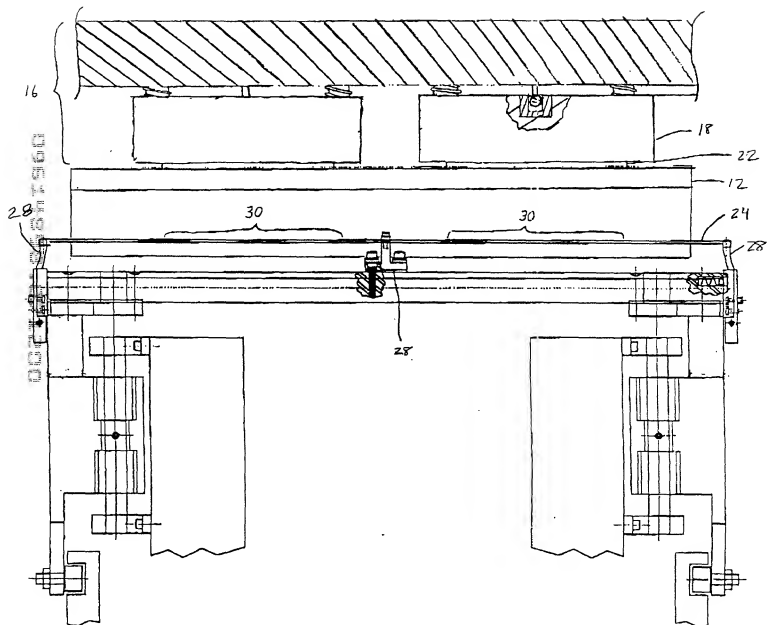


FIG. 2

FIG. 3



05-400-071200

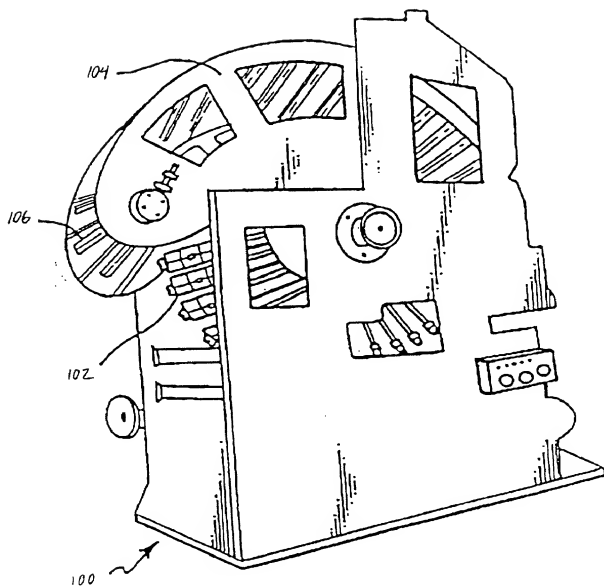


FIG. 4

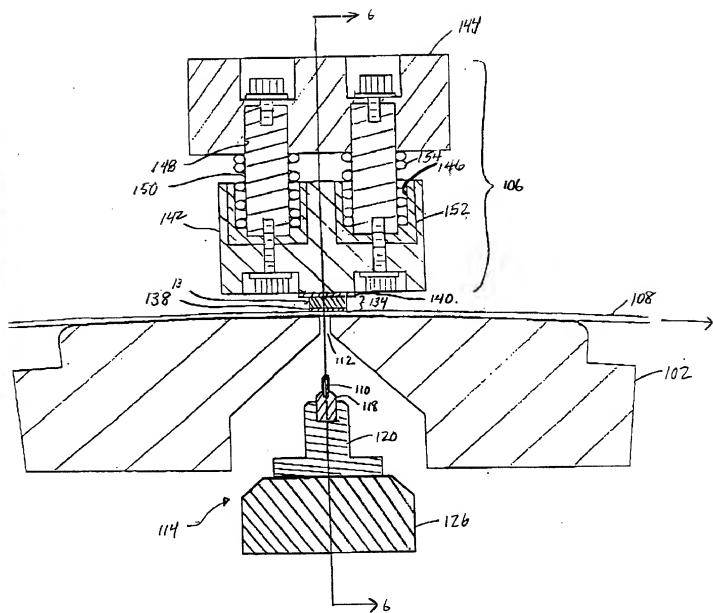
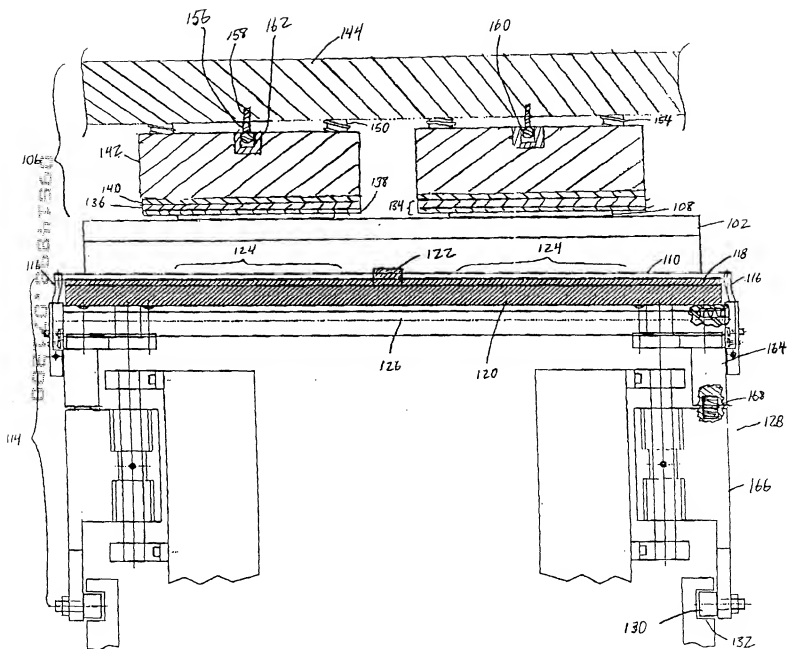


FIG. 5

FIG. 6



COMBINED DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, we hereby declare that:

Our residence, post office address and citizenship are as stated below next to our name:

We believe we are the original, first and sole inventor (if only one name is listed herein) or an original, first and joint inventor (if plural names are listed herein) of the subject matter which is claimed and for which a patent is sought in the invention APPARATUS FOR AND METHOD OF SEVERING AND SEALING THERMOPLASTIC FILM which is being filed herewith.

We hereby state that we have reviewed and understand the contents of the above identified specification, including the claims.

We acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

We hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Country	Appln. No.	Filed (Day/Mo/Yr.)	Priority Claimed (Yes/No)
<hr/>			

We hereby appoint J. William Frank, III (Reg. No. 25,626), David J. Houser (Reg. No. 29,172) or Laura L. Bozek (Reg. No. 38,085), Kristin L. Chapman (Reg. No. 38,102) and Robert A. Miller (Reg. No. 26,956) as our attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

Address all correspondence to:

S. C. JOHNSON HOME STORAGE, INC..
Patent Section - M.S. 077
1525 Howe Street
Racine, WI 53403
Telephone: (262) 260-2722

RECEIVED
JAN 10 1990
FBI - JEFFERSON

COMBINED DECLARATION AND POWER
ATTORNEY FOR PATENT APPLICATION

J-2850
Page 2

We hereby declare that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patents issued thereon.

Full Name of Sole or First Inventor: Clark Woody
Inventor's Signature: *Clark Woody*
Date: X 7/10/00 Citizen Subject of: U.S.A.
Residence: 1585 North Mackinaw Road, Pinconning, MI 48650
Post Office Address: c/o S. C. Johnson Home Storage, Inc., 1525 Howe Street, MS077, Racine, WI 53403-2236

Full Name of third Inventor: P. Gregory Velez
Inventor's Signature: X *P. Gregory Velez*
Date: X 7/10/00 Citizen Subject of: U.S.A.
Residence: 5143 Gatesboro Drive, South, Saginaw, MI 48603
Post Office Address: c/o S. C. Johnson Home Storage, Inc., 1525 Howe Street, MS077, Racine, WI 53403-2236

Full Name of third Inventor: Jeffrey S. Hoffman
Inventor's Signature: X *Jeffrey S. Hoffman*
Date: X 7/10/00 Citizen Subject of: U.S.A.
Residence: 866 West Prevo Road, Linwood, MI 48634
Post Office Address: co S. C. Johnson Home Storage, Inc., 1525 Howe Street, MS077, Racine, WI 53403-2236

Full Name of second Inventor: Stephen P. Gangler
Inventor's Signature: X *Stephen P. Gangler*
Date: X 7/10/00 Citizen Subject of: U.S.A.
Residence: 7020 Forest Road, Unionville, MI 48767
Post Office Address: c/o S. C. Johnson Home Storage, Inc., 1525 Howe Street, MS077, Racine, WI 53403-2236

00514698.071200